Dale Bumpers National Rice Research Center
USDA-ARS
Stuttgart, Arkansas

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MONTHLY RESEARCH HIGHLIGHTS

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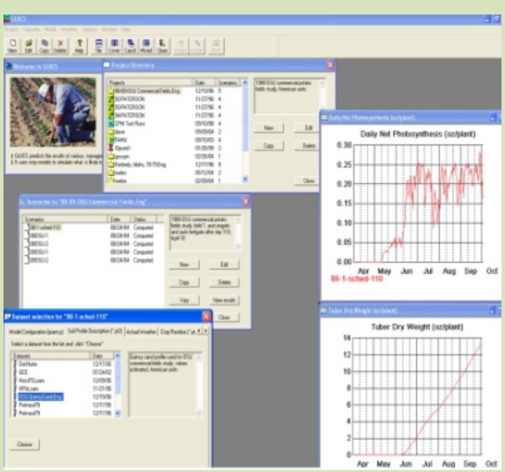
- **Recent Scientific Publications**

This addresses USDA-ARS Research Goal: Enhanced knowledge of how growth and development of crop plants are controlled at the physiological level

Li, S., Fleisher, D.H., Wang, Z., **Barnaby, J.Y.**, Timlin, D., Reddy, V.R. Application of a coupled model of photosynthesis, stomatal conductance and transpiration for rice leaves and canopy. *Computers and Electronics in Agriculture*. 182:106047. 2021. http://doi.org/10.1016/j.compag.2021.106047

Physiological assumptions incorporated in crop models need improvement to more realistically represent responses to heat stress, rising CO_2, and genetic diversity. Coupling of leaf-level photosynthesis and stomatal conductance sub-models within an energy balance has been proposed to improve gas exchange predictions underlying many of these responses. Our results indicate the use of a coupled energy balance model can more accurately predict rice gas exchange processes compared to uncoupled photosynthesis/transpiration methods when simulating responses to different CO_2 and temperature conditions, and thus may provide more realistic assessments of current and future climate impacts on rice production. The improved estimates of photosynthetic rates, particularly in response to higher CO_2 and temperatures, illustrate the importance and impact of the energy balance approach for improving photosynthesis, and potentially transpiration, simulations. They also provide a more direct approach to explore effects of climate factors on plant response on a more mechanistic basis.



This addresses USDA-ARS Research Goal: Crop plants with superior product quality for consumers

Siaw, M.O., Wang, Y.J., **McClung, A.M**. and Mauromoustakos, A., 2021. Porosity and hardness of long-grain brown rice kernels in relation to their chemical compositions. *LWT*, *144*, p.111243.

Harvested rice from the field must go through a milling process to produce the white milled rice that is most commonly consumed. The amount of whole milled grains produced, minus the amount of broken grains, largely determines the economic value of the crop. Thus, having rice varieties that produce high milling yields is important to growers and rice millers. Rice kernel hardness is an important factor influencing grain breakage during milling. Grain hardness is influenced by the internal porosity of the grain, where the starch granules are not densely packed. The basis for these loosely packed starch cells is due to the interaction of grain chemical components like starch, proteins and lipids. This study evaluated the impact of rice proteins and lipids on grain porosity and hardness. Brown rice kernels of similar thickness from four cultivars were subjected to protein denaturation by heat treatment and/or lipid removal by chemical extraction and then were characterized for kernel porosity and hardness. In general, as kernel porosity increased, kernel hardness decreased. In addition, factors that influenced porosity were primarily the quantity of proteins and lipids in the grain. In contrast, the continuity of the protein-starch matrix within the kernel was the main factor controlling kernel hardness. These results show the importance of chemical composition on kernel hardness and demonstrate ways to improve rice and its processing to increase economic value.

- **Technology Transfer**

✓ **<u>Interactions with the Research Community</u>**

April 20-21, Dr. Yulin Jia attended a joint virtual workshop on gene-editing organized by USDA and Agriculture and Agri-Food Canada (AAFC). Gene editing is an important new tool for breeding. This workshop built on a series of discussions aimed to build networks and identify potential cooperative research activities between USDA and AAFC. Current technology for gene editing, technology transfer, regulatory processes and communicating to the public were discussed. About 71 scientists and administrators from USDA and AAFC attended the workshop and discussions.

On April 21st, the USDA-ARS Stuttgart location celebrated Earth Day. As part of that, Dr. Ming Chen made a presentation on “Byproducts of Rice: Utilization and Opportunity”. She described how most rice is consumed as a milled product, resulting in high volumes of rice hulls and rice bran are co-products of the milling process. Because of the high silica content of rice hulls, they degrade slowly, resulting in a waste issue, although the are alternative uses being developed for hulls as a pressed board product, insulation, or being burned for energy. In addition, rice bran is generally sold as an inexpensive animal feed. Dr. Chen has been conducting research to better utilize rice bran as whole grain brown rice or as an ingredient, thus increasing crop value and co-product utilization.

✓ **Rice Germplasm Distributed**

During the month of April, 91 rice genetic stocks were shipped to researchers in the United States and Iceland from the Genetic Stocks Oryza (GSOR) collection.

- **Stakeholder Interactions**

April 5, Dr. Trevis Huggins reviewed images of rice plants growing under greenhouse conditions for a researcher at the University of Manitoba, Canada, to assess plant health. It was recommended that the iron be applied to the plants.

April 13, Dr. Anna McClung met with an entrepreneur interested in growing heirloom rice cultivars in the Arkansas Delta area. The history of rice cultivation in the USA and landrace varieties important for US production were discussed.

April 19, Ms. Lorie Bernhardt, Computer Assistant for the Genetic Stocks Oryza (GSOR) collection, provided information trait data and Landrace Improvement Status to a researcher at Empresa de Pesquisa Agropecuaria e Extensao (EPAGRI) at Santa Catarina, Brazil.

April 21, Dr. Yulin Jia provided guidance to a University researcher on blast resistance gene analysis and to a grower on disease management in an organic vegetable farming operation.

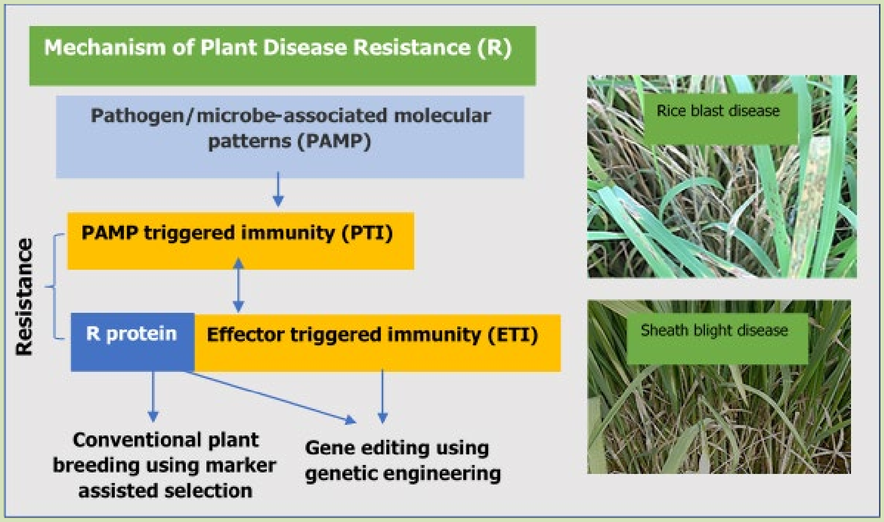
April 23, Ms. Bernhardt provided information to a grower about seed testing required for exporting seed to Ecuador.

April 27, Dr. Shannon Pinson, Research Geneticist, provided information to a Maryland Extension Agent regarding what a farmer should consider when selecting a rice cultivar and obtaining untreated seed suitable for aerobic organic rice production in the short Maryland growing season. Dr. Pinson provided names and contact information for persons currently producing organic paddy rice in other NE USA states, and for rice specialists with the California Extension Service and at RiceTec, a private hybrid rice company; and also provided digital copies of the California Rice Production Manual and the Arkansas Furrow-Irrigated Rice Handbook, each of which contain sections on cultivar selection and pest management.

- **Education and Outreach**

Jia, Yulin and Jia, Melissa H. 2021. Physiological, ecological and genetic interactions of rice with harmful microbes. (Book Chapter) IntechOpen. https://doi.org/10.5772/intechopen.97159.

Rice is one of the most important food crops for mankind and suffers significant crop loss annually due to rice diseases. Availability of genome sequences of rice has served as a springboard to utilize its innate immunity to prevent rice diseases. Knowledge on the interactions of rice and rice pathogens has rapidly accumulated. Effective resistance genes have been identified from cultivated rice, weedy species, and wild rice relatives and their role in plant innate immunity have been uncovered. Presently, rice diseases are being managed using host resistance genes and pesticides in diverse cultural systems around the globe. This chapter presents a review of interactions of rice with harmful microbes causing the two major diseases, rice blast and sheath blight. The review is written to target new readers in life sciences. Knowledge and critical literature on physiological, genetic, and ecological aspects of host-pathogen interactions are presented to gain insights leading to sustainable disease control.



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